City Mills Company, 1828
18th Street and First Avenue
Columbus
Muscogee County
Georgia

HAER GA-25

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

Historic American Engineering Record
Heritage Conservation and Recreation Service
Department of the Interior
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HISTORIC AMERICAN ENGINEERING RECORD

THE CITY MILLS

HAER GA-25

Location: 18th Street and First Avenue, Columbus, Georgia

Dates of Construction:
Old corn mill: 1869 A
Flour mill: 1890-1891 B
Brick office and warehouse: 1890 C
Old elevator: 1890 D
Concrete elevator: 1914 E
One-story warehouse: 1934-1937 F

Original Owner: Seaborn Jones owned site and built the first gristmill there in 1828.

Present Owner: The City Mills Company

Significance: Grist milling has been continuous at the site since the City Mills were established in 1828. Some of the newer buildings house offices, equipment, and warehouses used in the production of feed. The corn mill, no longer used, was built by Horace King, a noted black builder and an ex-slave. Much equipment remains in place in the older buildings, including an intact hursting frame in the flour mill supporting seven run of grindstones. Other equipment in the flour mill, including a 50-year-old water turbine, is occasionally used. The history of the site well illustrates the relationship between the commercial and technological evolution of a company.

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THE CITY MILLS

Commercial grinding of wheat and corn has been continuous on the site of the City Mills Company since the establishment of Columbus in 1828. The company is presently engaged in the production of animal feeds. All buildings constructed since 1869 remain standing, with much of the machinery still in place. The newer buildings house offices and warehouses; the 1890 warehouse holds equipment used in the company's feed production. Remaining in the old mill buildings are turbines, electrical equipment, and some milling machinery. The flour mill houses a complete hursting frame supporting seven grindstones. It is unusual to find these frames in such intact condition.

The persistence of City Mills offers an opportunity to study the effects of economic and technological changes on a company engaged in a commun U.S. industry. In addition, the mill was the first of many hydropower users at the Falls of the Chattahoochee in Columbus, and in the 1890's it became involved in hydroelectric development at the site. In order to present the history clearly, this report is divided into the following sections: Early History and Present Condition of the Site; Business History; Hydropower Development; Milling Machinery Development; Present-Day Process Flow; and a Conclusion.

EARLY HISTORY AND PRESENT CONDITION OF THE SITE

In 1828, Seaborn Jones, a wealthy planter from central Georgia, established a small water-powered gristmill on the Chattahoochee River at 17th Street, near the northern limits of newly-founded Columbus. By the 1860's, three other mills operated at Columbus, making City Mills the "old" gristmill. [1]

In late ante bellum years, City Mills had four run of stones, two grinding corn for meal and two grinding wheat for flour. The increased demand during the Civil War years greatly expanded the production and facilities of all Columbus gristmills. Although most of these establishments were spared by General Wilson's Union troops in 1865, it is probable that City Mills did burn, for in 1869 a group of businessmen built a new mill on the site. [2]

The new building, a three-story wood structure known as the "corn mill," is now the oldest of the complex of buildings (see Columbus: Drawings 4 and 4b). Horace King, an ex-slave, supervised construction. King is best known for his covered bridges; the City Mills corn mill is one of the few buildings associated with him [3] and is an interesting example of his work. Some of the original hand-hewn heavy timber framing remains in the mill (see CMC photo 1) and exhibits mortise-and-tendon jointing. [4] The addition of corrugated metal siding on the building exterior, and the replacement in 1915 of decaying interior

wooden floor joists by steel beams, obscure other aspects of original building construction (see CMS photos 2 and 3 for view of mill before covering with metal). Although the mill originally had five run of stones and produced meal, flour, grits, shorts, and bran [5], it was still a relatively small-scale operation compared with other local mills (see, for example, HAER, Columbus Report, Empire Mills).

The most important period of construction at the site was from 1890 to 1908 and was presided over by George A. Pearce. Pearce had been with the mill since starting as a mechanic in the 1870's, rising to become mill manager and the proprietor's son-in-law. In 1890, he organized and received a charter for a new City Mills Company, incorporated on June 2, 1892. [6] The extensive construction of an entire mill complex undertaken by Pearce reflects his commitment to developing a larger, more significant establishment (see "Business History" for commercial considerations prompting the construction program, and "Hydropower Development" for detailed discussion of simultaneous dam and powerhouse construction).

Initial construction in 1890 included a two-story brick warehouse, topped by a monitor, and a wooden grain elevator, both still standing (the elevator was covered with corrugated metal siding in 1944). [7] The elevator was erected 70 feet east of the old corn mill as a fire precaution, and the warehouse is located south of the elevator (see photos CMC 4 and 5, and Columbus Drawing 4, City Mills Site Plan). An iron bridge, which replaced a wooden one in 1899, connects the two buildings and once supported a corn conveyor (see CMC photo 6). At the time of construction, local newspapers described the elevator as a "massive structure"; its 94-foot bins had a capacity of 52,000 bushels, with room for 20,000 more unenclosed. To power the elevator's equipment, a rope drive ran from the third floor of the corn mill to an outdoor pulley near the top southeast corner of the elevator. When two additional floors were built on top of the warehouse in 1914, a long rectangular opening was left in the brick wall to permit the rope drive mechanism to enter the elevator; this opening and its counterpart in the corn mill are all that remain of the rope drive (CMC photo 7). [8]

Construction of an additional grinding facility, now known as the "flour mill," began as the other buildings neared completion. The Richmond City Mill Works of Richmond City, Indiana, designed the existing six-story brick building, just south of and communicating with the corn mill (CMC photos 8 and 9; also Site Plan, Columbus Drawing 4, for dimensions and spatial relations of the new construction). [9] The upper floors served as grain storage areas, while the first four floors were equipped as a modern grist-milling operation (see "Milling Machinery Development"). The machinery for the flour mill ran from its own battery of water turbines; an arched tailrace ran beneath the building, releasing water from the corn mill turbines (see CRR photo 1). The building's structure remains essentially the same as when built, with

the exception of iron girders replacing those of decaying wood on the first floor in 1904. [10]

In 1914, the City Mills Company enlarged its warehouse by adding two stories (enclosing the monitored roof, sections of which are still visible inside the building) and built a large, 100,000-bushel concrete grain elevator just north of the wooden one to supplement storage capacity (CMC photos 6, 10). A brick addition to the warehouse completed in the same year housed the company offices. The only addition since has been the construction in 1937 of a one-story brick warehouse extending east from the old warehouse/office. This was enlarged in 1946 by a brick 73x90-foot one-story extension. [11]

The activities within the building have been adapted and modified. The southern portion of the old warehouse still houses the company offices. Feed production now centers in the northern portion, converted to this use in 1937 (see "Milling Machinery Development"). Grain for feed production is stored in the old elevator; the concrete elevator stands empty. No grinding is done in either the corn or the flour mill. However, some shafting in the flour mill is used occasionally to transmit power from the mill's one functioning water turbine to drive an auger conveyor in the old warehouse (see "Hydropower Development") [12] All equipment remaining in these buildings will be described in later sections.

BUSINESS HISTORY: THE EVOLUTION OF A PRODUCT LINE

Prior to 1890, City Mills was one of several small grist-milling establishments within Columbus grinding both wheat and corn. After the Civil War, production gradually increased. Between 1876 and 1880, meal production increased from 200 to 500-600 bushels a day. [13]

City's production increase coincided with the burning of the Palace Mills. The elimination of a competitor meant more business. Another local competitor, the Columbus Factory complex at the Clapp's Factory site upriver, went bankrupt in the 1880's and left City Mills and Empire Mills alone to vie for the Columbus market. [14]

Pearce incorporated the City Mills Company in 1890 and began his pursuit of the Columbus market. The hydropower expansion and mill construction previously discussed (see "Hydropower Development" and "Milling Machinery Development") were only part of a broader coordinated effort to establish a sophisticated and important milling operation.

A crucial part of this effort was Pearce's desire to bring a spur line of the Central of Georgia Railroad directly to City Mills to facilitate quick, efficient transportation of goods to and from the mill and to eliminate drayage charges. The value of such an arrangement is underscored by George Woodruff's petition in September 1890

for an injunction restraining the railroad from laying a track to City Mills. Woodruff's Empire Mills enjoyed spur line service and proximity to the Chattahoochee River loading docks. The court denied the petition, and by July 1891, the railroad completed the spur line which still serves the City Mills Company. [15] Pearce hoped that this, in addition to his mill expansion and introduction of roller grinding (see "Milling Machinery Development") would strengthen his position as Empire's competitor.

Business got off to an ominously inauspicious start in the flour mill. The expansion had cost more than anticipated, and the company directors were forced to admit in 1892 that they had "not made a dollar" on the new mill. Success with the recently improved corn mill sustained optimism regarding the company's prospects. [16] The increasing demand for corn meal helped City Mills weather the severe depression of 1893, which closed many small gristmills. [17]

During the late 1890's, construction of additions increased, and in 1908 the flour mill powerhouse was renovated and a new hursting frame was installed (details in "Milling Machinery Development"). In 1897, five additional stones greatly increased the company's corn meal capacity. [18] By 1900, the company's production had greatly exceeded its 1880 level; corn meal production alone had increased from 500 to 5,000 bushels per day. The mill ran 24 hours a day during busy grinding seasons. [19]

Flour production did not increase as dramatically. Although the mill's capacity for flour was greatly expanded, the production of 300 barrels per day in 1900 was just half the 1880 maximum capacity (of course, it is not clear how closely that maximum was ever approached). [20] Attracting business for the flour mill was difficult. Pearce reported to his stockholders in 1909 that "we have all our new equipment that we put in last year all in tune and up-to-date, but have not been able, on account of the demoralized condition of the meal and flour business, to run it." [21] The subsequent history of the City Mills Company certainly suggests that the improvements and additions from 1890 through 1908 resulted in the overdevelopment of the mill's capacity. Several factors contributed to this situation. The interaction of hydropower and milling expansions tended to push each development forward; increased power provided opportunity for mill expansion, and extensive mill expansion demanded increased power.

Factors external to the company were also of key importance. The great grain-growing states in the Midwest were becoming bulk flour producers in the 1870's and 1880's. Large mills using roller grinding took advantage of their proximity to steady grain supplies and advantageous freight rates to flood the eastern states with inexpensive, quality flour. The older gristmills in the east, combining small roller installations with grindstones, were unable to compete with the large

midwestern mills. [22]

Georgia mills felt this competition keenly. Georgia had been a major flour-producing state, and Muscogee County contributed significantly to the state's output. In 1860, gristmill products constituted 25% of the total annual value of products in Muscogee County; by 1880 this figure had dropped to 18%. [23] By 1890, bankruptcy and fire had eliminated several of the county's mills, and between 1904 and 1914 value of gristmill products for the entire state dropped 25%. Those of Minnesota, Kansas, and Illinois dramatically increased. [24]

It is not surprising, then, that City Mills experienced marketing difficulties after their 1890 expansion. Reports from 1899, when competition was "very sharp...with many new mills, shipping their goods into our territory," through 1915 reveal the struggle of the company to maintain prices at a profitable level. The influx of midwest flour limited the mill to a local market, which was greatly encroached upon during years of a good local corn crop, when little mills, powered inexpensively by gasoline engines, sprang up in rural areas. [25]

World War I had an important effect on the product line at City Mills. The mill experienced a wartime expansion of production by taking on government business, but the major expansion was not in flour production. The company enlarged a 1915 installation for grits production, increasing its daily capacity from 500 to 4,000 bushels, and was able to continue this line for several years after the war. However, demand contracted after the company invested in a new grits mill, and the equipment was dismantled in 1927, eliminating what had been for a short time a major product of the company. However, during the war the company had been able to establish markets for its corn meal in the larger southern cities. [26]

The importance of these commercial developments became clear in the following years. While the company's flour production equipment and its market remained significantly underutilized and undeveloped, the company was expanding its commercial and technological base in a way which could compensate for the ill-fated investment in flour production. After the war ended, the increased capacity of the mill exceeded the amounts of wheat and corn it could obtain for grinding. In addition, marketing the finished products was also difficult. [27] The post-war period saw an increasing reliance on its corn meal products. Grinding for animal feed increased in importance (this period saw the installation and expansion of the feed mill and Gruendler pulverizers--see "Milling Machinery Development"). Bolting of shorts, bran, and oats for feed accompanied wheat and corn grinding at the mill. [28]

The profitable nature of the local feed business continued to compensate for the small rewards from flour production. Despite the severely depressed conditions of the 1930's (meal business fell 34%

between 1929 and 1930; flour, 15%; scratch feeds, 19%; and fancy feeds, shorts, and bran, 37%), the company was able to invest in 1934 in the new feed mill installation. Despite doing grinding for the Red Cross and for the Federal Emergency Relief Agency, which greatly upped meal and flour production (see Table I), the company still felt harassed by ths usual competition in the flour market, especially by truck-transported Northwest flour being dumped in the Southeast. [29] Although the outbreak of war in Europe increased demand for American grain, the Government gave contracts only to the larger, more modern mills; City Mills could no longer secure Government flour contracts. [30]

The "war boom" began for City Mills in 1943. Circumstances of the war market had an interesting differential effect on the company's various products, which was ultimately reflected in the machinery operating at the mill. Production of meal jumped 61% from 1941 to 1942, and the tons of mixed feed doubled. In shar contrast, flour production dropped 53% to 5,979 barrels annually between the same years (see Table 1 and Graph 1). [31]

In 1944, the mill management decided to increase production of flour and to dismantle the "old, obsolete, and worn out" equipment which "could not turn out a satisfactory product." Some of the roller grinders were the originals installed in 1891. [32] Little of this equipment still remains in the flour mill; a few rollers can be found on the grinding floor.

Production of meal and feed remained high. In 1944, demand for feed was so great that the mill produced less than it might have sold, and the company installed its third and fourth Gruendler pulverizers. [33] The war boom, tripling profits between 1942 and 1943 and sustaining them at a high level through 1947, enabled the City Mills directors to expand facilities for a lucrative product. National and local market conditions guided the decision to abandon one process and its technology and to expand another from which greater rewards were expected.

HYDROPOWER DEVELOPMENT

An early map of Columbus (circa 1845) shows the City Mills dam extending across the Chattahoochee River in a jagged manner (see Columbus Drawing 2); one section extended west from the mill, a long section ran north parallel with the current, and a third crossed west to the Alabama shore. This construction took advantage of rock islands for support, as did later dams at the site. This early dam was wooden; other details of its construction are not known. [34]

This dam apparently remained unchanged after construction of the 1869 corn mill. The turbines sat beneath the grinding (first) floor of the mill. Water piled against the mill by virtue of the dam's irregular formation and passed beneath the mill, through the turbines, and out the

arched tailrace on the downstream side of the mill (CRR photo 1). In 1880, three Leffel turbines of 66, 56, and 40 inches turned below the mill, producing a total of 75 horsepower. [35]

No major changes to the dam are recorded until 1883. Early the previous year, the Eagle and Phenix Mills, a large textile concern, had purchased the City Mills property. Eagle and Phenix was preparing to rebuild and heighten the dam on its own property a mile downstream from City Mills. This would raise the Chattahoochee water level by two feet at City Mills, decreasing the available head at that site. Eagle and Phenix hoped, by acquiring the City Mills property, to forestall legal interference with its construction program. [36]

The transaction, however, involved responsibility as well as gain for the Eagle and Phenix Mills. A condition of the purchase was that Eagle and Phenix maintain in good condition the City Mills dam. The old wood structure leaked badly and sagged in places below its original height. Consequently, Eagle and Phenix in 1883 made extensive repairs to the dam, supervised by company engineer D. W. Champagne. [37] This "new" wooden dam was of a type known as a rafter dam. Cheap log cribbing was incorporated with more sophisticated frame construction, a combination providing a relatively solid dam at low cost. The dam still zigzagged across the Chattahoochee, supported by outcroppings of rock. [38]

In 1890, George A. Pearce, who had leased the City Mills since 1883, purchased the property from the Eagle and Phenix Mills. [39] An important aspect of his expansion program of the mill were his plans for increased river utilization at the site. Construction of the flour mill necessitated additional power facilities; the 75 horsepower developed by the three corn mill turbines was insufficient for both mills. The company in 1891 built a small wheelhouse adjacent to the west wall of the flour mill (see photos CRR 2, CMC 10). Three 66-inch specially built Leffel turbines drove, via vertical shafts and bevel gearing, the main drive shaft of the new mill (see photo CMC 11 and Columbus Drawing 6). Three millwright's wheels (see CMC photo 12), devices which control the opening of the turbine wickets, were located on the grinding (second) floor of the mill. A person on the grinding floor could open or close the wickets, regulating the speed of the turbines and therefore the speed of the grinding stones. [40]

Pearce's plans for power generation at the site went beyond satisfying his own requirements. In 1891-1892, the section of the wooden dam running west from the corner of the old corn mill was replaced by a higher rock wall forming the bulkhead of the new wheelhouse and extended beyond it 35 feet into the river (see Site Plan, Columbus Drawing 8). In the wall were two large "ways," each about 20 feet wide, through which workmen could draw off the ponded water when making repairs. By 1894, the north-south extension of the dam was also replaced with stone

and reached 75 to 80 feet from the downstream wall to the eastern end of the wooden section, which extended about 500 feet to the Alabama shore. This improvement enhanced the power potential of the site. [41] (See CMC photos 13 and 14 for layout of 1894 dam.)

That Pearce originally intended to provide a potentially significant power site is revealed in a report to his stockholders of November 21, 1894. He announced the decision to sell to the Columbus Railroad Company "the surplus power which we provided for when we built the extra stone wall and gates west of tbe flour mill." [42] The Railroad Company leased both the site and the power it developed in its own power station, built in 1894-1895 due west of the flour mill wheelhouse (see CRR photo 3). This station became the first centrally generating hydroelectric plant in Columbus (see HAER Report, "Columbus Railroad Company Powerhouse," for details of lease and subsequent history).

The Hardaway Contracting Company of Columbus late in 1904 started construction of the rubble masonry dam. The new structure did not follow the zig-zag shape of the earlier dams but ran straight back from the rock wall at the western end of the Columbus Railroad Company's powerhouse at an angle of approximately 20 degrees. The dam, resting not on rock islands but on solid bedrock, extended 700 feet across the river. This dam, completed in 1907 at a total cost of $90,000, continues to pond water for the City Mills Company. [43] (See CMC photo 15.)

One result of this construction was an increase of one-third in the power imported to the mill's turbines. [44] This increase had been demanded by the increased utilization of the water power site, and by the expansion of the gristmill. The additional power available enabled the mill, in turn, to again improve and extend its facilities.

Many of the improvements involved the wheelhouse of the two mill buildings. From 1904 to 1907, excavation of the riverbed beneath the old corn mill deepened the wheelpits and cleaned the tailrace. In 1908, the wooden walls and ceiling of this wheelhouse were replaced by concrete, leaving the wooden wheelpit floor and head gutters.

The existing wheelhouse for the flour mill was built during the same period; the concrete support of this building bears the date "1908." Three new turbines replaced the old and were fed through four grated intake gates. These improvements were a direct response to construction of the new dam.

Pearce's heavy investment in hydroelectric power at the City Mills site was threatened by the troublesome and erratic flow of the Chattahoochee River (for discussion of problems engendered by low and high water, see "Water Development at the Falls of the Chattahoochee," HAER Report, 1977). Low water plagued the installations at the site; the Columbus Railroad Company feared difficulties meeting its power

commitments. The dam required continual patching to ensure adequate water flow through the turbines. [45]

Tiring of this uncertain situation, City Mills, late in 1901, began to take contractors' bids for a new stone dam to be built across the Chattahoochee. [46] Several reasons prompted construction at this time in addition to the constant repair work required on the old dam. Extensions and improvements to the milling facilities (see "Milling Machinery Development") demanded increased power. The demand for electricity was increasing; the Columbus Railroad had developed additional horsepower in 1897, increasing their rent due to the City Mills Company, and the City Mills directors were confident the railroad company would develop and pay for still more. The full and secure utilization of the developed power at the site required a stronger, more efficient dam. [47] The new stone dam, constructed between 1904 and 1908, represented an investment in the future of hydroelectricity at the site.

Unfortunately for Pearce, circumstances external to his own company destroyed the future of hydroelectric generation at the site. In 1900, the Columbus Power Company built a large hydroelectric facility at North Highlands (see Columbus Drawing 2). The Columbus Railroad Company used that station as an alternate source of wholesale power, which it distributed to Columbus over its own wires. The railroad company was contemplating much larger developments upstream. By 1906, the year of consolidation of several upriver power interests (including affiliates of the Columbus Railroad Company), the City Mills powerhouse was overshadowed by existing and planned developments. [48] (See "Water Power Development at Falls of the Chattahoochee" report for details.)

The City Mills Company consequently experienced difficulties realizing an acceptable return on its investment in hydroelectric power. From 1901 through 1917, Pearce sought through a series of lawsuits to force the railroad company to pay rent for the additional horsepower which it had developed but no longer used. The controversy was finally settled in 1917 by an agreement establishing a fixed rental for the railroad company's two western turbines independent of actual use, in exchange for removal from the City Mills pond of condensing water for the railroad company's steam plant. [49]

Upriver construction and water utilization was a problem for the City Mills Company in another respect. Pearce was concerned with the effect of water storage at North Highlands on the volume of water available at the City Mills' turbines. He also attempted to forestall diversion of water from his pond by the Columbus Water Works Company; an agreement was finally reached in 1912 after six years of controversy. [50] The many users of the Chattahoochee were crowding each other, and City Mills seemed especially pinched.

Until 1919, the City Mills Company used its turbines exclusively

to provide mechanical power for grist-milling operations; Pearce purchased all his electricity from the Columbus Power Company. During 1919, several factors prompted City Mills to install a 175-kilowatt General Electric generator above the westernmost turbine of the flour mill wheelhouse. The Columbus Railroad Company had proposed an increased charge of electricity in the old corn mill just at a time when more power was required. The expansion of facilities on the east side of the property (e.g., the new concrete grain elevator) rendered the wire rope transmission from the corn mill turbines to the elevators and warehouse insufficient. [51] City Mills was forced to pay increased charges for more power, or to provide itself with electricity.

The power developed at the flour mill wheelhouse had always considerably exceeded what could be used in the new mill. Installation of the generator alleviated the power imbalance between the two mills. The generator provided lighting, supplementary power for the elevator, and power for dryers and unloading machinery. It also drove a corn shucker and sheller installed at the same time as the generator.

The generator was placed on the second story of the flour mill wheelhouse, adjacent to the grinding floor of the mill. The vertical shaft from the turbine continued through the horizontal gearing for the main drive shaft to the generator on the floor above. The generator, with a Type V.R. 6x12 Woodward Company governor and oil pump (installed in 1937), a Westinghouse Type S.K. 10-horsepower direct current exciter, and a General Electric switchboard panel, remain in place in this room. [52] (See Columbus Drawings 4b and 5 Section AA, CMC photos 16 and 17; see also Appendix 3.)

This addition helped solve the power problem in the old mill. The added security was enhanced by a flexible arrangement of the power transmission network. If operation of the older water turbines were impaired, all the grain-handling machinery could be run by electricity, probably via belting from electrically powered to water-driven shafting. [53]

City Mills nonetheless continued efforts to increase the efficiency of its water-driven apparatus. In 1922, the company placed a 45-inch Samson turbine under the old corn mill, and another was installed in 1924. These joined two 40-inch wheels installed in 1915. In the flour mill, all three wheels were replaced in 1929 by three 62-inch Leffel Samson turbines. The company employed useable parts of the worn 20-year-old wheels when possible, cutting the installation cost to $5,348. [54]

George A. Pearce died on August 11, 1933, and J. P. Illges, whose family had long been prominent stockholders, succeeded him as president. The severely depressed economic conditions seemed to inhibit Illeges's commitment to improvements, particularly regarding work on the dam and

powerhouses. Only makeshift repairs were made on badly rotted watergates and rusted turbine runners. City Mills, now realizing the insignificance of the central station at the site, was anxious to avoid major repairs while waiting for the power company to allow its lease to lapse on the unused powerhouse (which it finally did in 1950).

Since the turn of the century, production of corn meal and feed were increasingly important in the city's product line (see "Business History"). Improvements in the late 1940's reflected this increased significance. Production of meal and feed centered in the old corn mill and warehouse. In 1946, the company remodelled and rebuilt the corn mill wheelhouse, providing concrete floors and walls and a new steel headgate. The same year, City Mills placed in operation a 312-kVA Westinghouse generator on the first floor of the corn mill. It produced 600-volt 3-phase 60-cycle current at 600 rpm. Three new 45-inch Leffel Samson turbines, replacing the four older ones in the remodelled wheelhouse, powered the generator, which apparently met most of the power requirements for the mill. The company expected the generator, coupled with the new turbines in the remodelled wheelhouse, to facilitate mill operation during high water. These turbines, the generator, and a Woodward Type V.R. 7x12 governor (part of the original installation) remain, with their belts and drive shaft, in the corn mill. [56] (See CMC photo 18.)

PRESENT-DAY USE

None of the hydromechanical or hydroelectric equipment in the corn mill is presently in use. Operations ceased in that building in the late 1960's. [57] The tailrace running beneath the flour mill has been bricked at the northern end, rendering the corn mill turbines inoperable. The electrical equipment on the second floor of the flour mill does not function. All electricity is purchased from the Georgia Power Company.

Of great interest in the flour mill powerhouse is the still-functioning easternmost water turbine (installed in 1929). The mill manager occasionally employs this turbine to power an auger conveyor carrying grain from the production area of the old warehouse to a "standby" Gruendler pulverizer in a shed east of the flour mill grinding floor. [59] The rusted and inefficient turbine spins the mill's main drive shaft, belted from the large easternmost pulley to a drive shaft and countershafting on the third floor, which motivate the conveyor.

The turbine is also capable of powering an old freight elevator in the southeast corner of the flour mill which, although still operable, is not generally used. Two lether belts connect the third floor drive shaft to the elevator mechanism. When the elevator is stationary, the belts are each engaged to a loose idler pulley. One belt is threaded so as to criss-cross itself as it stresses across the room, reversing the direction of rotation of its pulley. The other belt is threaded

normally. The idler pulleys therefore spin in opposite directions. Between them is a tight pulley belted to the small spindle mechanism which winds the elevator cable. A double control rope in the elevator shaft activates one of two bolt mechanisms, which lifts one of the moving belts onto the center pulley. The elevator cable winds or unwinds, moving the platform up or down, depending on which belt has been transferred. (See CMC photo 19.)

The two other turbines remaining in the wheelhouse, and transmission shafts in the mill, no longer function. They do remain in place, giving an accurate picture of the power facilities when the mill was operating. (See also "Milling Machinery Development.")

MILLING MACHINERY DEVELOPMENT

Until the 1890's, City Mills did only stone grinding. In ante bellum years production was small, with only four stones installed. The 1869 corn mill was slightly larger, with a run of five stones.

It has been already noted that when George A. Pearce organized the City Mills Company in 1890, he intended it to be a large, important concern. Not only had the flour mill, with its 13 run of stones, a greater capacity than the corn mill; in 1891, Pearce introduced stands of rolls into his partially constructed mill. Roller milling, introduced in the United States in the 1870's, produced a much finer, whiter flour. The largest mill in Columbus, Empire Mills, had introduced roller grinding at least a decade earlier; Pearce was placing himself in a position to compete successfully with Empire Mills in the manufacture of fine flour. [60] (See "Business History for discussion of the broader significance of roller milling in the company's history.)

Pearce continued modernization through the following two decades. In 1898, he partially replaced his reel system of flour separation with a modern sifter process, noting that "the flour machinery has advanced with the progress of the times." In 1903, heavier, more stable shafting went into service in the flour mill. [61]

The improvements made on the dam and powerhouses between 1904 and 1908 doubled the available power to the mill, and additions to the milling machinery took advantage of the increase. In 1904, the handling capacity of the grain elevator, powered by corn mill turbines, was doubled. By 1908 the company had remodelled the corn mill itself, adding new corn stones, corn cleaning machinery, and heavier shafting.

A major change in flour mill equipment accompanied the 1908 renovation of the flour mill wheelhouse. The building then housed, in addition to flour rollers, 12 run of stones of 180 revolutions and two run of 400 revolutions. (See Appendix 1 for mill equipment in 1907 prior to this renovation.) These stones probably ground corn rather than flour. [62]

During 1908, Pearce removed this equipment and installed a large hursting frame (hursting refers to the wooden framework supporting the grindstones of a mill) 45 feet in length, with vertical timbers 12 feet 2 inches high and 11 inches square. This frame was designed to support eight stones (although only seven were installed at City Mills), as well as the main drive shaft of the mill. [63]

This frame, extending from the first to the second level of the building, remains standing with all its shafting and gearing in place, providing an accurate picture of its connections when installed in 1908 (see CMC Drawings 5, Section AA, and 6). A heavy drive shaft runs from the wheelhouse into the mill, passing through the frame. At the west end of the frame are three driving wheels; the westernmost turns a thick leather belt extending to the fourth floor; the others drove equipment installed in later years, as did the large wheel at the eastern end of the frame. (See CMC photos 20, 21, 22.)

The gearing for the seven 48-inch horizontal grindstones can be seen within the cogpit of the hursting framework (see photo CMC 23, Drawing 5, detail A and C). The large vertical gears, turning with the main drive shaft, once engaged the smaller horizontal gears which send narrow shafts to the stones, but the gear teeth have now been separated by several inches (see CMC photo). Seven bedstones and six runner stones remain in place and last ground corn in the 1960's (see photo CMC 24).

Both the grindstone rotation and the turning of the main drive shaft generated vibrations which could be dangerous if transmitted to the building and foundation. For this reason, the frame is not bolted directly to the floor of the mill but rests on 11 wooden pads, which isolate the frame's vibrations. [64] (See CMC photo 20.)

Subsequent history of the City Mills Company suggests that Pearce's continuing efforts to modernize were ineffectual because of the small size and the geographic location of his mill (see "Business History"). Despite improvements in 1913 to the flour mill (perhaps in anticipation of an increased war demand) which enabled the mill to handle better qualities of hard wheat, corn products and animal feed continually increased in importance at the expense of flour throughout the 20th century. [65]

By the end of the 1920's, the City Mills establishment strongly reflected this trend (see Appendix 2). In the corn mill, the turbines powered 13 corn grindstones. Also on the grinding floor of this mill stood a Draver mixing apparatus (see "Present-Day Process Flow" for description) for combining a number of ground products for feed (today, a set of Dravers remain in the grinding floor of the corn mill behind a wall at the southern end of the room, which might have been their location in the 1920's). [See photo CMC 25.]

In the flour mill, corn ran through the eight grindstones. Eighteen 9-inch double roller mills devoted to flour and three devoted to feed also stood on the grinding floor. The company had a daily capacity of 500 barrels of flour and 8,000 bushels of meal. All the mill products were packed on the third floor of the flour mill, carried there by conveyor systems. [66] (Some of this equipment, including the feeder bin for the bag closing machine, remains on the third and fourth floors.) (Photos CMC 26 and 27; see also Appendix 3.)

In 1929, the company concentrated its feed operations in a modern feed mill (location not specified). The managers at the same time installed on the second floor of the flour mill a large Gruendler pulverizing mill, a hammer mill used to crush a variety of grains used in feed. The machine was driven by a belt from the middle western wheel in the main drive shaft below. [67]

The profitable nature of the local feed business continued to compensate for the small rewards from flour production. In 1934, the company realized that its feed installation was too small and cramped for production of a quality feed at low cost. The directors therefore agreed to rebuild the feed mill on three floors of the old warehouse. [68] The bins and Dravers installed are still used today for feed production (see "Present-Day Process Flow"). By 1944, three additional Gruendler pulverizers for feed production were in operation, two placed in line with the original machine on the flour mill grinding floor and one "standby" in a shed by the mill's eastern wall. [69] The latter machine is still in use; the other three remain in place, beside three large air blowers which whisked chaff from the machines up pipes to the roof (CMC photo 28, Columbus drawing 4b).

PRESENT-DAY PROCESS FLOW

Animal feed has remained the major product of the City Mills Company, which today supplies a small local market. The company cracks its own corn, grinds peanut hulls, and crimps oats. These are mixed with purchased pre-processed grains to produce scratch feed, pellets, and sweet or wet mashes. Employees unload grain from train cars to the lowest level of the mill. Elevators carry the grain to the fifth floor, where it either passes through or bypasses a cleaner (operated by a motor-driven shaft once turned by the rope drive). Chutes carry the grain to a grinding bin or to any of 16 storage bins in the old elevator. Grain must be removed to the three southernmost bins for conveyance by elevator to the production processes in the warehouse. [70]

The production process at the mill involves three interdependent systems, the grain, the pellet, and the Draver systems. The product of the grain system is scratch grain, a dry mix of cracked corn, wheet, and other grains. Corn is brought by grain elevators to corn crackers on the third or fourth floor of the warehouse, where the corn is heated and

popped. The corn then travels through chutes (corn cracked on the third floor is elevated to these chutes) to a cleaner. Here, air removes the husks, dust, and fine dirt. Elevators then carry the corn to the fifth floor, where it is dumped into the fourth floor corn bin above the Draver apparatus. On the fifth floor, a roller either crimps oats or prepares wheat, and feeds these grains into the appropriate bins above the Dravers. The Dravers pass the grains to the second-floor bagging apparatus.

The Dravers are used primarily, however, in the production of sweet or wet feeds. The main set of seven Dravers, similar to but larger than the old set in the corn mill, are on the third floor. The bin above each Draver holds a different grain. Lever-controlled "doors" allow predetermined amounts of each grain to drop into the Draver to be shaken and sifted onto the auger beneath. After a 90° turn, the conveyor mixes the grains with molasses, piped from a tank on the fourth floor, and with ingredients from four additional Dravers. These sweet feeds are also "bagged out" on the second floor.

Feed pellets for chickens, pigs, rabbits, horses, and catfish are major products of the mill. Ingredients must be mixed in the proper proportions before entering the pellet machine. Until the mid-1960's, the Dravers did this mixing. The present manager, believing the inaccuracies of the Draver system to be wasteful and expensive, installed a standard two-ton mixer on the second floor. On the floor above, electrically operated automatic batch scales measure and release grain from any of seven bins into the mixer far more accurately than could be done by the Dravers.

Grain drops from the mixer into a surge bin on the first floor. Elevators raise it to a holding bin on the third floor, from which it enters a Century 100 California Pellet Machine on the floor below. The pellets pass through a fan-operated cooler on the first floor, then are elevated to the fifth, where a shaker separates the pellets from from smaller particles. Fully formed pellets move to the second-floor bagging area, while smaller material is returned to the pellet machine.

The three production systems are not distinct. Corn and hulls ground at the mill can enter bins above either the Dravers or the mixer. Sweet feeds can be sent to the pellet machine as well as dry mixes. This interdependence allows the mill some flexibility of operation.

CONCLUSION

Technological evolution is never isolated, but interacts continually with other factors, principally social and economic, and, increasingly, political. The history of City Mills reveals that, at least in the case of a small local gristmill, undoubtedly typical of many others, technological development and investment were far more opportunistic

than rational, and calculated for survival rather than innovation.

For example, City Mills did not install roller grinders when they were first introduced in the United States, despite their being the most advanced milling technology of the day. The previous investment in grinding stones, and the small size of the City Mills market, discouraged installation. Pearce finally installed rollers in the 1890's as part of his competitive bid for Empire Mills' fine flour market, a commercial rather than a technological consideration. The economic and commercial perspective is essential in understanding the slow adoption of a modern technique in this small Southern mill.

Similar motivations are found in the company's move to animal feed manufacture. The removal of flour milling machinery from the site, the gradual addition and expansion of feed production, down to the newly installed batch mixer, clearly reflect the changes in the company's product line. This, in turn, was motivated by one concern: the continued commercial viability of the company. Understanding the company's business history therefore aids interpretation of the technology extant (and removed) at the site.

Pearce's investment in hydroelectric power clearly illustrates the complex relationship of technology and economics. Pearce appreciated the clearly growing demand for electricity and expected to reap rewards from the Columbus Power Company station. Erratic river flow at this particular site, however, was intensified by its sandwiched position between the Eagle and Phenix and Columbus Power Company dams. Within a few years, technological advances in hydroelectric generation and power transmission, as well as the economy achieved by bulk power production, resulted in larger hydroelectric installations. The Columbus power interests turned their attention to more valuable sites up the river; the City Mills powerhouse became obsolete within a decade after its construction.

Pearce's initial investment had been heavy, and he invested still more in dam improvement, hoping to improve the quality of the site. Although the power station never fulfilled his expectations, Pearce's efforts had an interesting effect on his mill machinery. As the company improved its power facilities, milling capacity was expanded to take advantage of the power increases. Milling capacity was spurred beyond the mill's ability to find material to grind. The company's over-expansion, a serious business problem, was strongly interrelated with power development at the site.

During the crises of the two World Wars and the Depression, Government intervention in the flour and meal industries helped shape City Mills' commercial and technological development. During the first World War, Government requirements prompted installation of dryers for wheat and corn and for the finished products, meal and grits. [71] This

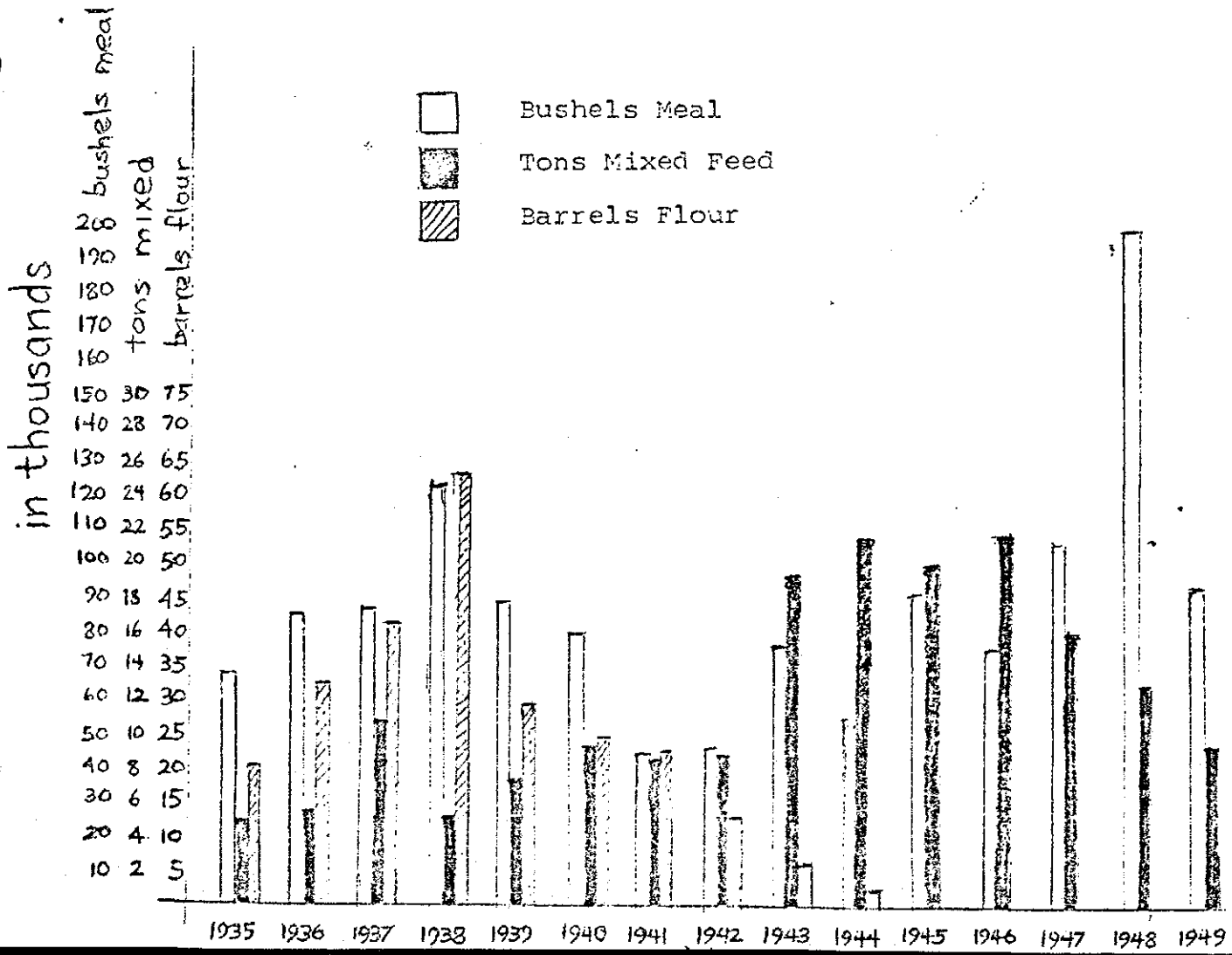
increased the company's ability to deal with damp grains and probably boosted the company's grits market for a short time after the war. During World War II, the Government's exclusive patronage of more modern, larger mills ended the Government contracts which City Mills had secured during Depression years. During the war, the company installed two new Gruendler grinders for feed production and dismantled the flour milling machinery.

Consideration of all factors influencing the development of the mill as a whole is essential in understanding the technological evolution of the company. The fact that City Mills "survived" so long, adapting its technology to a variety of changing circumstances, makes it an excellent study for exploring the important interaction between technical, economic, and social factors in American history.

Table 1. Products, City Mills Co., 1935-1949.
Compiled from the Sec'y-Treasurer's Report for each year, City Mills Company Records. Figures for Tons Fancy Feed have not been employed.

Year	Bushels Meal	Tons Mixed Feed	Barrels Flour
1935	67,853	4,938	21,788
1936	85,142	5,818	32,423
1937	88,836	10,134	40,949
1938	122,203	5,210	63,275
1939	92,556	7,285	28,772
1940	79,995	9,135	24,142
1941	41,022	8,122	22,704
1942	46,559	8,423	12,785
1943	75,051	18,595	5,979
1944	53,561	21,613	2,000
1945	90,327	20,212	
1946	73,206	22,235	
1947	104,677	15,798	
1948	197,942	12,572	
1949	92,461	9,319	

Graph 1.



Footnotes

1. The grist mill upriver at the Clapp's Factory complex began operation in 1838; in 1848, Winter's Palace Mills was established; by the late 1850s, Empire Mills opened for business in downtown Columbus. See John H. Martin, compiler, Columbus, Georgia, From Its Selection as a "Trading Town" in 1828 to Its Partial Destruction by Wilson's Raid in 1865, (Columbus, Ba., 1874), Vol. I, 96, Vol. II, 36, George White, Statistics of the State of Georgia, Savannah, 1849, 446-448; Muscogee County Superior Court, Deed Book M, pp. 129-131, 7 June 1854, p. 321, 16 September 1867.

2. Scientific American V (29 June 1850), 322; Columbus Daily Engineer (CDE) 28 June 1853; Diffee William Standard, Columbus, Georgia, in the Confederacy, The Social and Industrial Life of the Chattahoochee River Port, (N.Y., 1954), 29-30; Columbus Enquirer-Sun, 4 September 1878, states specifically that the "large flouring mills" were not burned in 1865; however, the CDE wrote on 7 July 1869 that "messrs. Duer, Pridgen, Ligon, Stapler and others are rebuilding the City Mill above the Commons in the northern liberties." Even the foundation was new. In addition, the article "City Mills on the Chattahoochee," Miller's Review and Dixie Miller (January 1927) states on p. 11 that "a mill was standing there when the Federal raiders came in 1865 and they burned it."

3. It is possible that King supervised construction of the old mill at Clapp's Factory (see photos WPD 2, 3 and 4). In 1869, King was one of the most active and respected contractors in the Columbus area. He first came to Columbus with his master, John Godwin, a bridge-builder. Godwin taught King the trade; together they constructed the first span across the river at Columbus in 1832. After going to Ohio, where King was freed in 1846 (avoiding the legal encumbrances to manumission in the Deep South), the pair returned to Columbus and worked together until Godwin's death in 1859. At the close of the Civil War, King was the most skilled builder in the region, and constructed covered bridges throughout the Chattahoochee Valley, including the "upper bridge in Columbus in 1868. See Columbus Daily Sun, 14 April 1866, 18 September 1867, 8 March 1868, 26 August 1868; CDE, 5 May 1868, 7 July 1869; "Horace King," typescript, Loretta Lamar Chappell, probable author, Columbus College Archives.

4. Columbus H.A.E.R. team architect, Donald Stevenson, believes the mortise-and-tenon technique to be "background" in 1869, illustrating that King's primary training was in techniques prevalent in the 1820s and 1830s.

5. CDE 8 September 1874, advertisement for CMC; 1880 Census Manuscript, Columbus industries, Georgia State Archives, Atlanta, Georgia; Report of the President, 31 October 1915, City Mills Company Records (CMR), Columbus, Georgia.

6. Nancy Telfair, A History of Columbus, Georgia, 1828-1928, biographical sketch of G. A. Pearce; Charter and By-Laws of the City Mills Company, incorporated 2 June 1890 (CMR).

7. Secretary-Treasurer's Report, 1 January 1945, CMR.

8. Reports of the President, 15 November 1899, 31 October 1914, Minutes of Directors' Meetings 5 February 1891, 10 August 1891 CMR: CDE 1 May 1891, 4: 2; transcript of testimony during Columbus Power Company vs. City Mills Company, 1900 (CPC vs CMC, 1900), p. 146. The bound transcript was found in the City Mills records. The information here is, of course, possibly inaccurate, due to the vagaries of individuals' memories, and care was taken in interpreting testimony.

9. CDE 1 May 1891, 4:2. The Richmond City Mill Works were established in 1876 after Nordyke and Marmon moved their plant to Indianapolis from Richmond City. The new plant hired the skilled ex-employees of Nordyke and Marmon, and the company was quite successful. Richmond Daily Palladium (Richmond, Indiana), 3 January 1905.

10. Directors Meeting 9 November 1892, letter of D. T. Sullenberger to CMC, 17 January 1938, Report of the President, 11 November 1904, CMR.

11. President's Report 31 October 1914, Directors Meetings 16 December 1936, 9 January 1946, Secretary-Treasurer's Report 1 January 1938, 1 January 1946, 1 January 1947.

12. Oral interview, and tour of City Mills, with Robert Wadkins, mill manager, conducted by John S. Lupold, Barbara A. Kimmelman, and J. B. Karfunkle, 24 June 1977.

13. CPC vs. CMC, 1900, pp. 38-39, 146; CDE 8 September 1874; 1880 Census Manuscript, State of Georgia, Columbus industries.

14. Telfair, p. 67; The Industries of Columbus, Ga., Her Advantages as a Business Center, Manufacturing Locality and Healthful Habitation, booster pamphlet, Columbus, Ga., 1887 (Wm. Gilbert, printer); CDE 8 September 1874.

15. Directors' Meetings, 25 September 1890, 5 February 1891, CMR; CDE 7 May 1891, 4:2. In 1897, the Central of Georgia laid a second spur line to the City Mills property (President's Report, 7 November 1897).

16. Director's Meeting, 19 November 1892, CMR.

17. President's Report to Stockholders, 9 June 1893; President's Report, 21 November 1894, CMR.

18. President's Report, 7 November 1897, 31 October 1898, CMR.

19. 1880 Census Manuscript, State of Georgia, Columbus Industries; President's Report, 31 October 1891, CMR; CPC vs CMC, 1900, p. 149 (Pearce's testimony).

20. Ibid.

21. President's Report, 14 November 1909, CMR.

22. For impact of roller milling, and concentration of production in larger, midwestern establishments, see Herman Steen, Flour Milling in America, (Indianapolis, 1963), 36, 38-56; also David Wells, Recent Economic Changes (1889) quoted in Robert Keller, The Shaping of the American Past (Englewood Cliffs, 1975), p. 488. The tendency to concentrate capital in large establishments is well illustrated in the 1880 Census of Manufacturers; Georgia had 1,132 grist milling establishments, with $3,576,301 invested, while Minnesota had 436 establishments in which were invested $10,510,362 (figures from Table V, Selected Statistics of Manufacturers by Counties, p. 209).

23. In 1860, the annual value of products for Muscopee County grist milling totaled $363,000; value of all county products was $1,404,711. Muscogee County provided 8% of Georgia's total annual value of flour and meal products ($303,000 out of $4,550,007): Figures from 1860 Census of Manufacturers, Table II, "Recapitulation by Counties," pp. 80-81. In 1880, Muscogee County grist milling products totalled $564,142, while the county value of all manufacturers totalled $3,019,309: Figures from 1880 Census of Manufacturers, Table IV, "Manufacturers in Each State and Territory," pp. 104-106.

24. The % increase in value of product for Ceorgia, in the 3 5-year periods, 1899-1904, 1904-1909, 1909-1914, rose 3.8, then dropped 16.8 and 4.9; Minnesota jumped 11, dropped 3, and upped again by 5; Kansas jumped 30.3 in the first period, 28.9 in the second, before dropping .1, Illinois jumped 22.6, then 2.2, before dropping 2.7 Figures from 1914, U. S. Bureau of Census of Manufacturers, Flour and Grist Mill Products, "Comparative Summary by States."

25. During this time, City Mills established agreements with Empire Mills, "its strongest competitor" in efforts to maintain prices. President's Reports, 15 November 1899, 31 October 1901, 16 October 1903, 4 November 1906, 21 October 1907, 31 October 1913, 31 October 1915, memo August 1914, CMR. One interesting illustration of the mill's difficulties is Pearce's discussion in this 1915 report of 2 new turbines installed in the corn mill. He told his directors that he planned to use the new turbines "in making meal and handling the elevator at times we are unable to get enough to run the new mill." This, too, must have been a chronic problem.

26. President's Reports, 31 October 1917, 31 October 1918, 31 October 1919, CMR.

27. President's Report, 31 October 1919, Regular Directors Meeting 10 March 1921, CMR.

28. "City Mills . . . " Miller's Review, January 1927.

29. The company directors dewailed government intervention in the flour and meal trade, blaming it for depressed conditions, although they did not hesitate to accept government business during the Depression. President's Reports 31, December 1930, 31 December 1932, Secretary-Treasurer's Reports 1 January 1938, 2 January 1939, Reports to directors and stockholders 8 January 1935, 8 January 1936, CMR. There were, of course, year-to-year fluctuations in demand for each product, but the general trend was as described.

30. Secretary-Treasurer's Report, 2 January 1940.

31. Figures from Secretary-Treasurer's Reports, 1941, 1943.

32. Secretary-Treasurer's Report 1 January 1945, Sollenberger letter 17 June 1938.

33. Secretary-Treasurer's Report 1 January 1944, 1 January 1945.

34. "Plan of Columbus, Georgia," map circa 1845, Columbus College Archives.

35. 1880 Census Manuscript, State of Georgia, Columbus Industries; examination of site.

36. Deed of transfer to the Eagle and Phenix Mfg. Co., 14 February 1882, CMR; CPC vs. CMC, 1900, pp. 48, 53-54. The crowding of users at the Chattahoochee Falls in Columbus resulted in many such difficulties. See also H.A.E.R. reports Eagle and Phenix Mills and Water Power Development at the Falls of the Chattahoochee for more detailed discussion.

37. CPC vs. CMC, 1900, pp. 22, 100-101 (Champagne's testimony), 29 154 (Pearce's testimony), 108-125 (workmen's testimony). A new, tighter dam would pond more water than City Mill's old dam, particularly compensating for Eagle and Phenix's increased dam height.

38. CPC vs. CMC, 1900, pp. 239, 37.

39. Deed of transfer, Eagle & Phenix to Geroge A. Pearce and William Tillman, 2 October 1890, Deed of transfer, Ceorge A. Pearce and William Tillman to City Mills Company, 2 October 1890.

40. 1880 Census Manuscript, State of Georgia, Columbus Industries; CPC vs. CMC, 1900, p. 164; physical examination of the site.

41. CPC vs. CMC, 1900, pp. 73-84, 149-150, 165, 167, 171, 218, 269, 277; pencilled note in black of CPC vs. CMC, answering charges against CMC; President's report to stockholders, 21 November 1894.

42. President's Report to Stockholder, 21 November 1894.

43. President's Report (Annual), 15 November 1899, 31 October 1902, CMR.

44. President's Report, 16 October 1901, CMR. Due to disruptive river flow and other unstated reasons, actual construction was not begun until 1904. President's Report, 11 November 1904.

45. President's Report, 18 November 1897, CMR; City Mills Co. vs. Columbia Power Co., petition of CMC, Muscogee Superior Court, Records of Writ 1908, p. 260.

46. President's Report, 11 November 1904, 16 November 1905, CMR; Telfair, in her biographical sketch of G. A. Pearce, discusses the 1904-1908 dam at some length.

47. President's Report, 21 October 1907, CMR.

48. Letters to George J. Baldwin (Col. RR Co.) from L. F. Garrard, 6 November 1901, from maanger of Atlanta office of General Electric, 12 February 1902, from H. S. Reynolds, 10 December 1903, George J. Baldwin Papers, Columbus files, Southern Historical Collection, University of North Carolina; see also Power Station of the Columbus Railroad Company, H.A.E.R. Report 1977. H. S. Reynolds (Co. RR mgr.) wrote in 1903 that "our old station is so poorly laid out that we are always in fear of either low water or high water. It is really of little value."

49. Board of Directors Meeting, 10 May 1904, President's Reports, 21 October 1907, 31 October 1908, 31 October 1909, 31 October 1910, 31 October 1911, 31 October 1914, 31 October 1917, letters to G. A. Pearce from J. S. Bleecker (Col. RR mgr.), 26 January 1914, 3 July 1914, copy of agreement between CMC and Col. RR Co., 1 July 1917, CMR; letter to Bladwin, 30 November 1901, to Stone and Webster from Baldwin, 15 November 1909, memo of 6 November 1909, letter to Pearce from Bleecker, 3 July 1917, Baldwin Papers, SHC, UNC. See Power Station of the Columbus Railroad Company, HAER, Report 1977, for further details of the 1917 agreement.

50. Memo to Pearce from McNeill and Henry, 25 September 1902, letter to City of Columbus and the Board of Water Commissioners from CMC, 27 August 1906, Board of Directors Meeting, 5 March 1907, President's Reports, 21 October 1907, 31 October 1908, copy of agreement between CMC and Frederick M. Colston et. al., 4 April 1912; letter to Baldwin from Reynolds, Baldwin papers, SHC, UNC.

51. President's Report, 31 October 1919, CMR; "City Mills . . .", Miller's Review, January 1927.

52. Examination of site; data on the equipment from the manufacturers plates.

53. President's Report, 31 October 1919, CMR; "City Mills . . .", Miller's Review, January 1927.

54. President's Report, 31 December 1929, letter from D. T. Sullenberger to CMC, 17 January 1938, CMR; "City Mills . . .", Miller's Review January 1927.

55. President's Report, 31 December 1932, Report to Stockholders, 12 January 1937, Secretary-Treasurer's Report, 21 January 1939, Sullenberger letter, 17 January 1938, CMR.

56. Secretary-Treasurer's Report, 1 January 1946, 1 January 1947, CMR; memo from R. B. Betts (Eagle and Phenix, engineer) to G. A. Byars, 20 June 1968, Eagle and Phenix Records, examination of site (manufacturers' plates).

57. Robert Wadkins interview.

58. All information through the end of this section from examination of the site.

59. Scientific American V (29 June 1850), 322.

60. Director's Meeting, 9 November 1892, Sullenberger letter, 17 January 1938, CMR.

61. President's Reports, 31 October 1898, 16 October 1903, CMR.

62. This was certainly the case in later years (see Miller's Review article): the fact that Pearce replaced his old stones with new ones, rather than with rollers, suggest that they were intended to process corn. For equipment in 1907, see Sanborn Insurance Map, Columbus, Ga., 1907, Map Collection, University of Georgia.

63. President's Reports, 11 November 1904, 31 October 1908, CMR; measurements of HAER architects, Columbus, Ga., 1977. Final installation was in mid-November 1908, at a total cost of over $30,000.

64. Above description of hursting frame from examination of the site.

65. President's Report, 31 October 1914, CMR.

66. Information in previous two paragraphs from "City Mills . . .", Miller's Review, January 1927.

67. President's Report, 31 October 1919, CMR.

68. Report to Stockholders, 8 January 1935.

69. Secretary-Treasurer's Reports, 1 January 1938, 2 January 1939, 1 January 1944, 1 January 1945.

70. All information in this section is drawn from the interview and tour with Robert Wadkins, mill manager.

71. President's Report, 31 October 1918.

Bibliography

Primary Sources:

City Mills Company Records. Minutes of Board of Directors' meetings, copies of Presidents' and Secretary/Treasurers' reports, both manuscript and typescript, collected in volumes, from 1891 through the 1950s. A remarkably complete collection, giving information on business history and technological development of the company.

Columbus Power Company vs. City Mills Company, 1900; bound transcript of court case found in City Mills Company records. In addition to interesting (if possibly inaccurate) information on various aspects of the company's history, the transcript elucidates the hydropower development between 1880-1900, and illustrates the difficulties arising between the cramped users of Chattahoochee River power.

Interviews:

Robert Wadkins, mill manager. Interview (untaped) and tour of City Mills plant, 24 June 1977, conducted by John S. Lupold, Barbara A. Kimmelman, and J. B. Karfunkle. Provided an excellent description of the present-day process, as well as helpful verification of dates and events.

Secondary Sources:

"City Mills on the Chattahoochee," The Miller's Review and Dixie Miller (January 1927), 18. Excellent accounting of all milling machinery within the mill in 1927.

Appendix I. Machinery in City Mills, 1907, from Sanborn Insurance Maps of Columbus, Georgia, 1907 (map collection, University of Georgia). (This map numbers flours from basement, 1, 2 . . . 5. I have number the floors in the text from 1, 2 . . . 6).

Flour Mill

Basement: shafting and conveyors

1st (grinding) : 11 stands of steel rollers
12 run stone of 180 revolutions
2 run stone of 400 revolutions

2nd : 1 bran duster
1 shorts duster
1 wheat steamer and 1 small VP.B.
6 sacking machines

3rd : 4 sifters, 4 reels, 4 bolts
1 140 barrel bin, one 500 bushel bin

4th : 4 purifiers, 2 scourers, 1 separator
1 sifter, 1 cockerel machine, and 4 reels.

5th : 3 reels, 1 screen, 4 cyclone dust collectors,
1 corn cleaning fan

Grist (corn) Mill

1st : 3 turbine wheels

2nd : Grinding

Attic : Storage

Capacity: 400 barrels of flour)
5000 bushels of meal) per 24 hours

Appendix II. Equipment at City Mills side, by floor, in 1927, From "City Mills on the Chattahoochee," Miller's Review and Dixie Miller (Jan. 1927), 18 - ?

Old Corn Mill

Wheelhouse (1st floor) - 2 40" Samson Leffel upright turbines, 4 45" Samson Leffel upright turbines.

Grinding floor (2nd floor) - 13 48" corn stones, upper runners, 3 feed buns with draver feeders (chick feed); 1 corn bin.

Third floor - 1 Woldron corn cleaner; 3 32x8" hexagon reels (meal); 1 9x18 double Barnard and Leas roll; corn bins; 1 Nordyck and Marmon packer.

Fourth floor - 2 32x8" hexagon reels (meal); 1 reel, size unspecified, (chick feed); 1 bin; 1 meal packer; 1 suction fan and dust collector; 1 large Komemade cyclone dust collector for corn separators; 8 elevator heads.

Flour Mill

Wheelhouse - 3 62" Samson improved upright turbines (630 hp under 9 foot head).

[First floor - hursting and main drive shaft]

Grinding floor (2nd floor) - eight runs of 48" cornstones; conveyor to bucket grain elevators; 21 double roller mills, 9" diameter; 18" Munson Machinery Company attrition mill; 2 Alsop electric bleachers; (in 2nd floor of wheelhouse) 1 175 Kw. General Electric generator, for light and power to corn sheller, dryer fans and unloading machinery.

Third floor - 3 flour packers, 1 Nordyck and Marmon 23x40 shorts duster; 1 bran duster; 6 No. 2 Buckleys, 2 Richardson Automatic Scales; 1 belt conveyor; 1 Economy bag closing machine; 1 magnetic separator; 4 20-inch Alsop agitator on draver feeder.

Appendix II, cont'd.

Fourth floor - 3 wheat scourers; 1 Perfection dust collector, 3 Great Western sifters; 28 sieves; 3 Nordyck and Marmon purifiers; 2 Gardner sifters and mixers with Fairbanks hopper scale (1500 lbs. capacity); 1 Nordyck and Marmon shorts duster and 1 Nordyck and Marmon bran duster; 3 flour feeders; 3 hexagon reels; bins.

Fifth floor - 1 Century Milling separator; 1 large Howes scourer, on corn; 2 hexagon reels for meal bolters; 4 round flour reels 32x8; Nordyck and Marmon centrifugal reels on flour; 2 Nordyck and Marmon 6x17 sifters; 5 Nordyck and Marmon purifiers; 2 exhaust fans on flour mill rolls; 1 magnetic (Howes Co.) separator on wheat; Perfection dust collector.

Sixth floor - 1 Carter oat separator; 1 magnetic separator on corn; 4 Perfection dust collectors; feed exhuast purifiers; 1 30-inch exhaust fan for feed rolls; 3 32x8 hexagon reels on feed; 2 round reels on flour; 1 24-inch aspirator with fan; 67 elevator heads for wheat, corn, and flour.

Appendix III. Equipment Remaining in Old Mills by Room

Flour Mill Powerhouse

1st floor

3 Leffel Samson turbines, installed 1929, engaged to main drive shaft of mill; easternmost still in operation; westernmost adapted to power electric generator (no longer used).

Main drive shaft with all necessary gearing, extending into first floor of flour mill.

3 driving wheels (and belts) to 2nd floor electrical equipment: westernmost belts to governor, middle to oil pump (part of governor system), easternmost to generator.

2nd floor

1 General Electric Alternating Current Generator (installed 1919), GE, Schenectady, NY., No. 305586, Type ATB 8-255 - 900, Form PB; I.S. #350082-2, P.F. [power factor]. 8; 3-phase, 217 amps, 60 cycles [volts illegible], N.P. 8507. This is the original generator installed in the building.

1 Woodward Waterwheel Governor, Woodward Governor Company, Rockford, Illinois. Type V.K., No. 7991, 5000 ft.-lbs. size 6x12, last patent date 11 August 1914.

1 Westinghouse direct current exciter, Westinghouse Electric and Manufacturing Company, East Pittsburgh Works, East Pittsburgh, Pa. Type S.K., 10 h.p., 115 volts, 76 amps, 1750 rpm, Style 74C 439, Frame 53, Hours 24; last patent date 13 May 1924.

1 General Electric Switchboard panel.

1 variable resister, and panel containing GE frequency recorders, voltmeters, ammeters, and 1 Allis-Chalmers "Rocking Contact" regulator.

1 "main" enclosed in pipe from generator from switchboard, and from switchboard out east wall of powerhouse.

(Note: switchboard equipment is probably not the original installation, and is of little historical interest)

Appendix III, cont'd.

Flour Mill

1st floor

1 main drive shaft

4 driving wheels on shaft (one at east side of hursting frame)

1 thick leather belt from westernmost driving wheel, extending to mill's 4th floor

1 narrower belt to Gruendler grinders on third floor

1 hursting frame

7 bevel gear complexes (to grindstones) within cogpit of hursting frame

2nd floor

7 run of grindstones (one runner stone removed).

metal pipes suspended from 3rd floor (fed grain to stones)

3 Gruendler Crusher and Pulverizer "hammer mills."

3 blowers with metal pipes to root several stand of rolls.

3rd floor

1 wheel and drive shaft (operating)

1 freight elevator mechanism (shaft runs through all six floors of the mill), two leather belts to drive shaft.

1 operating auger conveyor, with gear complex, and belt and countershafting from floor's main shaft.

1 A. O. Braff "Auto-Sacker", Serial No. 404, last patent date October 1914.

1 Unique suspended Flour Hopper Scale.

3 wooden suspended bins (similar to "Auto-Sacker").

Appendix III, cont'd.

Corn Mill

1st floor (wheelhouse)

a 3 Leffel Samson turbines (installed 1946).

2nd floor

1 Westinghouse alternating current generator (installed 1946), Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. 312 kva, 600 volts, 3-phase, 60 cycles, 600 rpm; Serial No. 2198821, S.O. 47A 39.

1 Woodward Waterwheel Governor, Type V.R., No. 6570, 6700 ft.-lbs., Size 7x12, last patent date 11 August 1924.

Drive shaft, gearing and belting to generator and governor.

1 Draver mixing apparatus with conveyor (behind wall at southern end of room).

No significant machinery on upper floors.